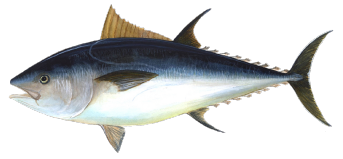
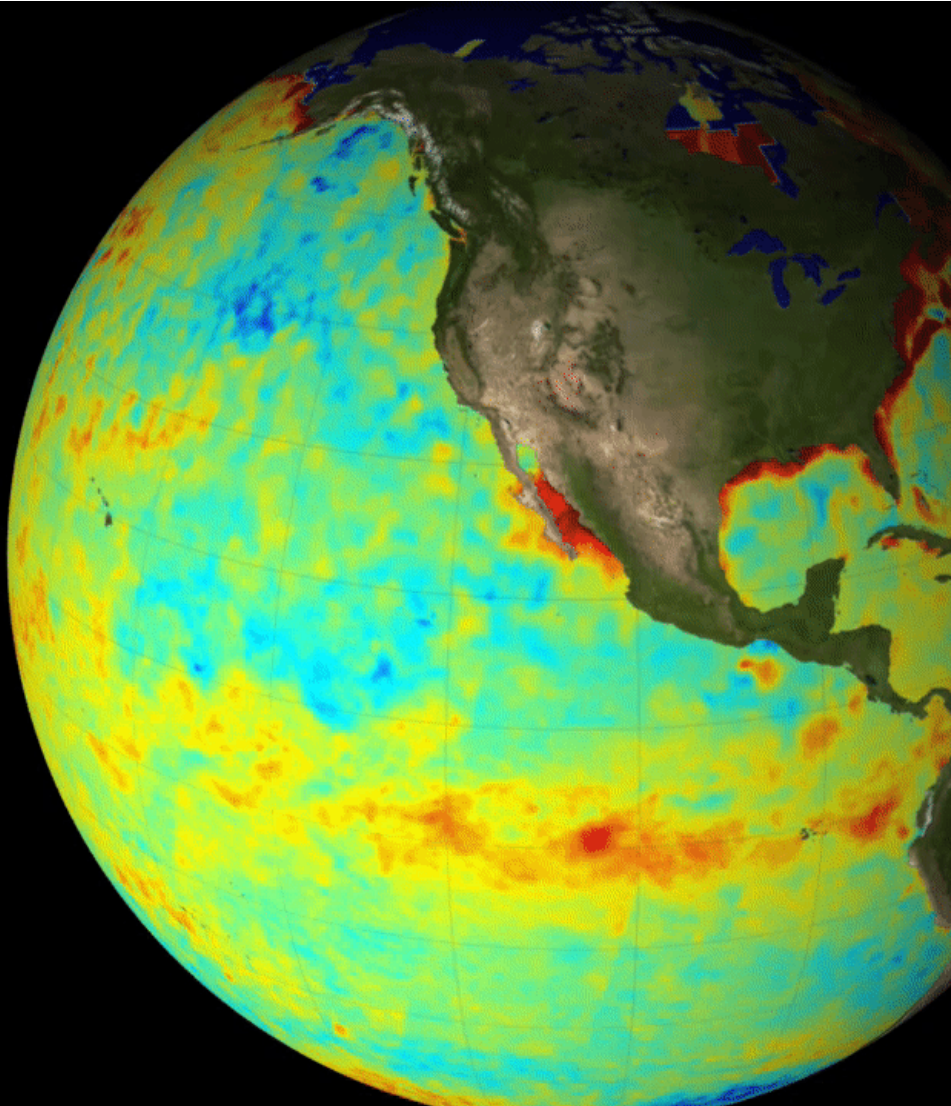


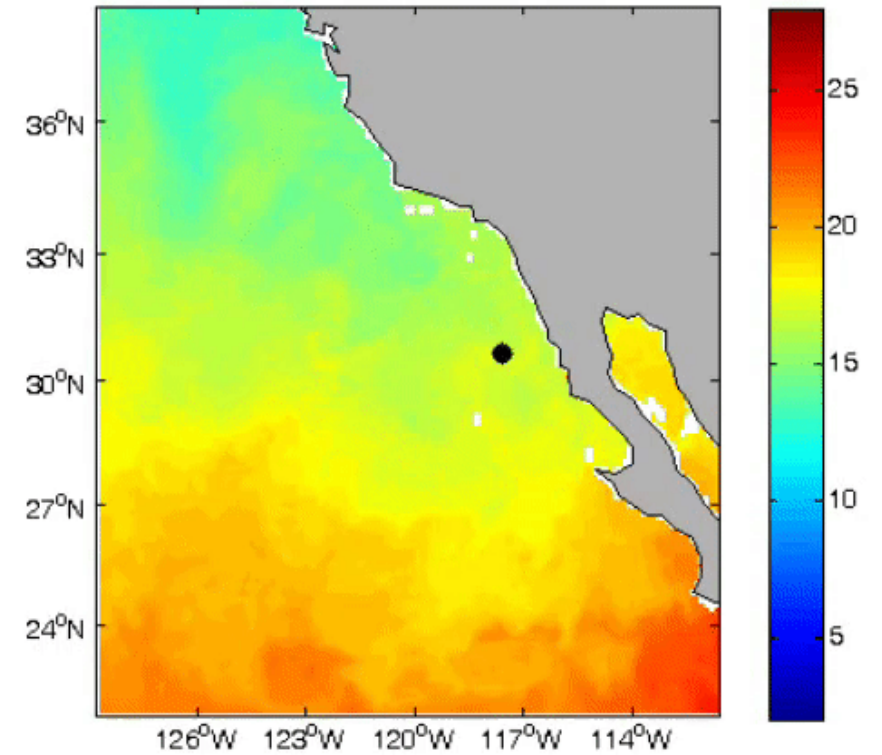
# 3.3 Dynamic Oceans and Dynamic Ecosystems



Jan 1 2007



18-Jan-2003



NOAA FISHERIES

# Cumulative Risks in the California Current

## Multiple Risks

- Ship strikes
- Bycatch / entanglement
- Noise
- Climate change

- Use satellite data to model species and risk in near real time

## Questions for TOR:

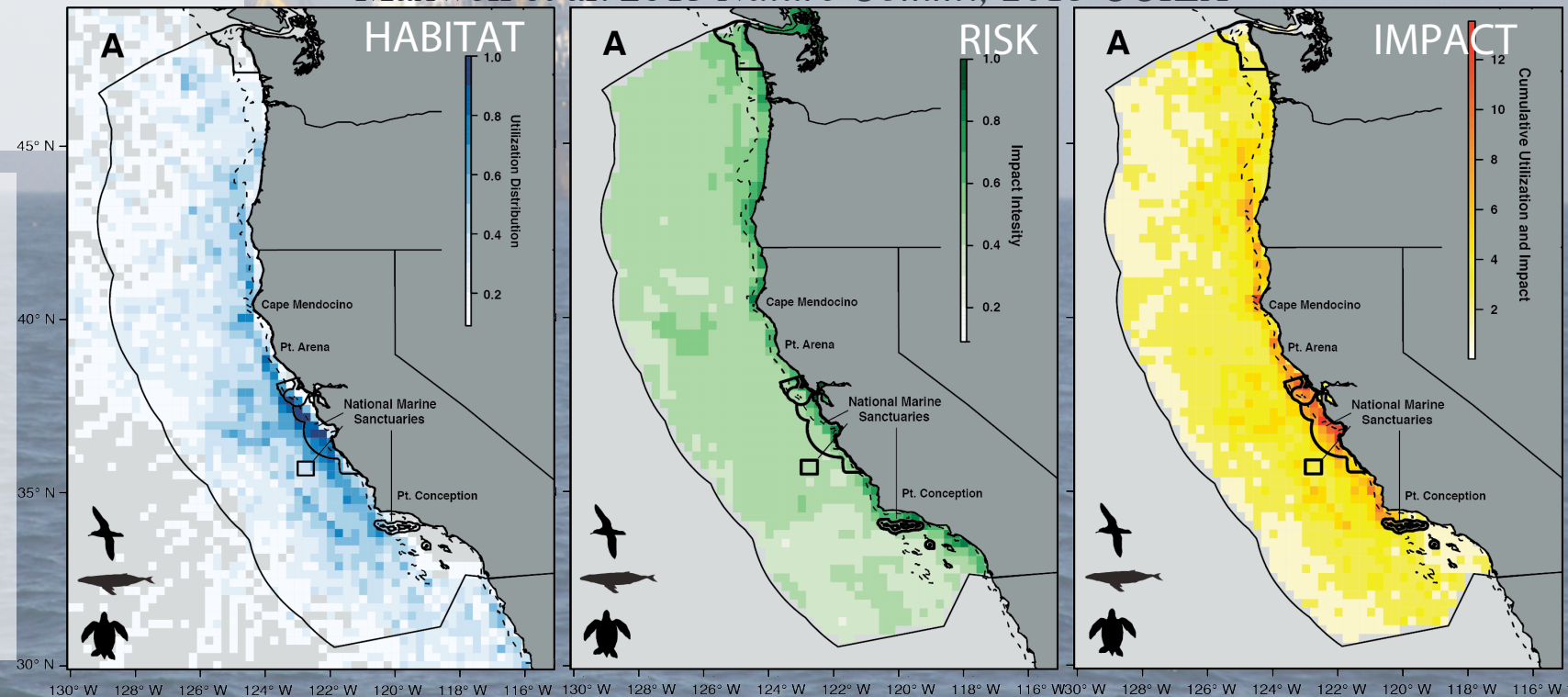
Q2 – Needs of Regional Office

Q4 – Ecological data to fill ecosystem needs

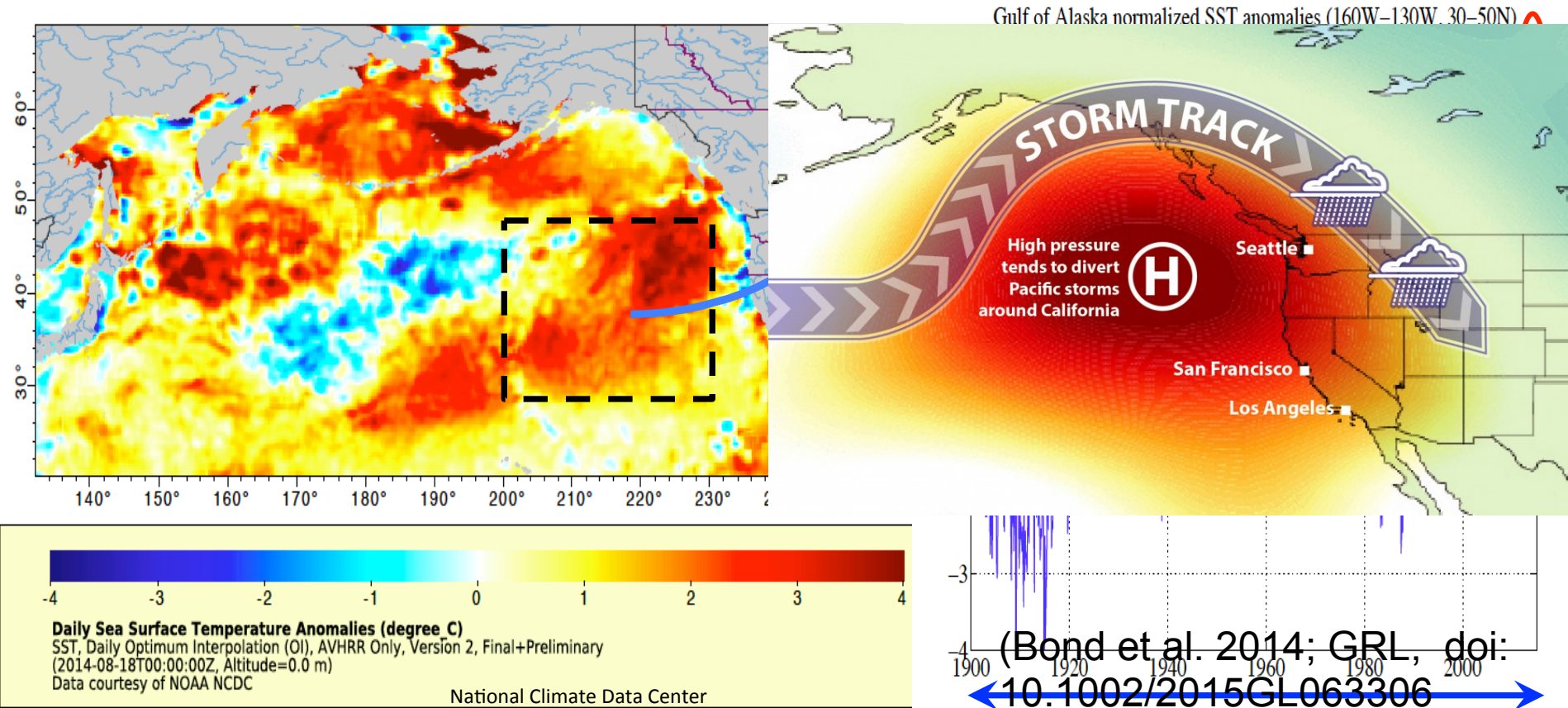
Q6 – ocean habitat to LMR management advice

Q8 – Communication of research to managers & stakeholders

Maxwell et al. 2013 *Nature Comm.*; 2013 CCIEA



**Climate Change Stress Test:** Beginning in 2012, the Western US and northeast Pacific Ocean have experienced a climate change “stress test” on our marine habitats.

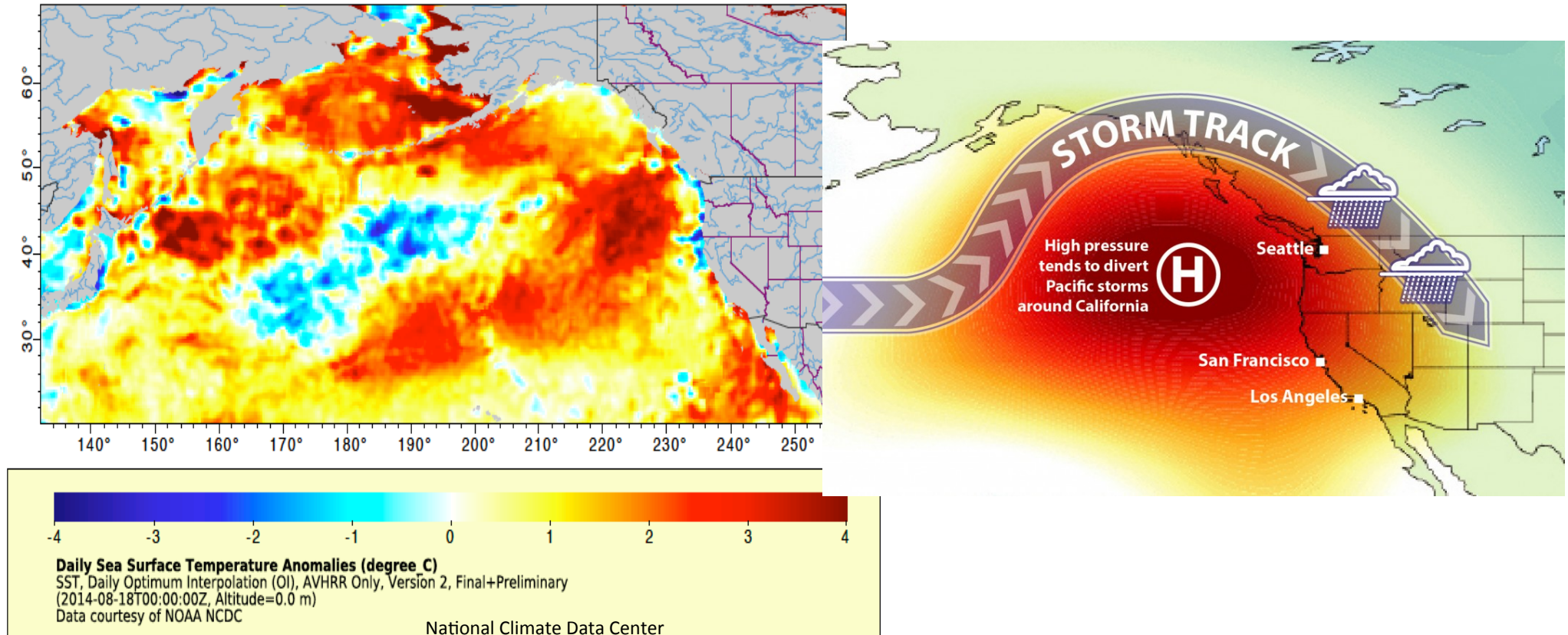


**Daily SST anomaly (18 Aug 2014) relative to the 30-year (1982-2010) climatology**

**114  
Years**

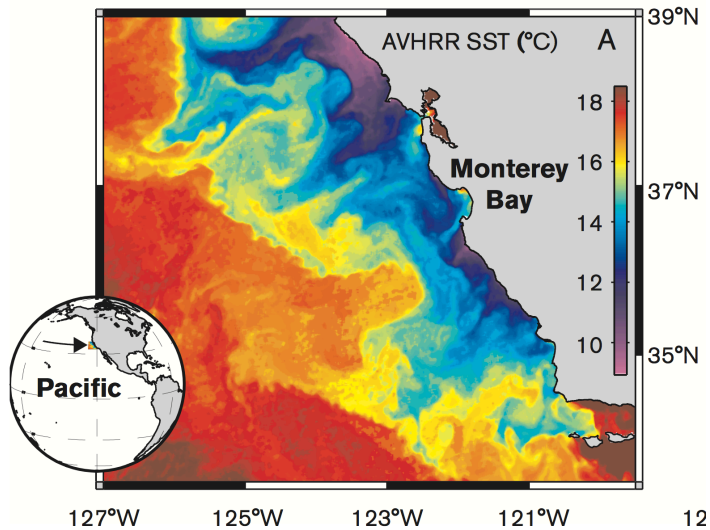
**The 100+ year time series of Sea Surface Temperature in the eastern Pacific shows this is the warmest**

**Climate Change Stress Test:** Beginning in 2012, the Western US and northeast Pacific Ocean have experienced a climate change “stress test” on our marine habitats.

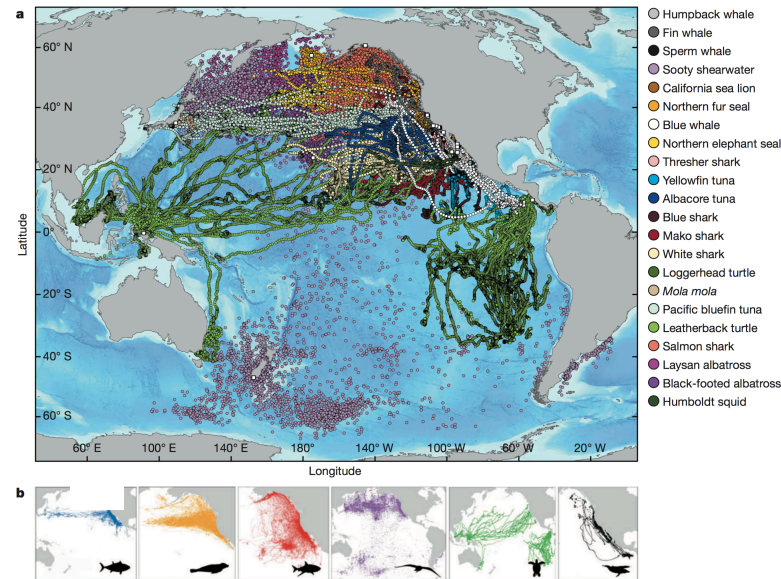


**Daily SST anomaly (18 Aug 2014) relative to the 30-year (1982-2010) climatology**

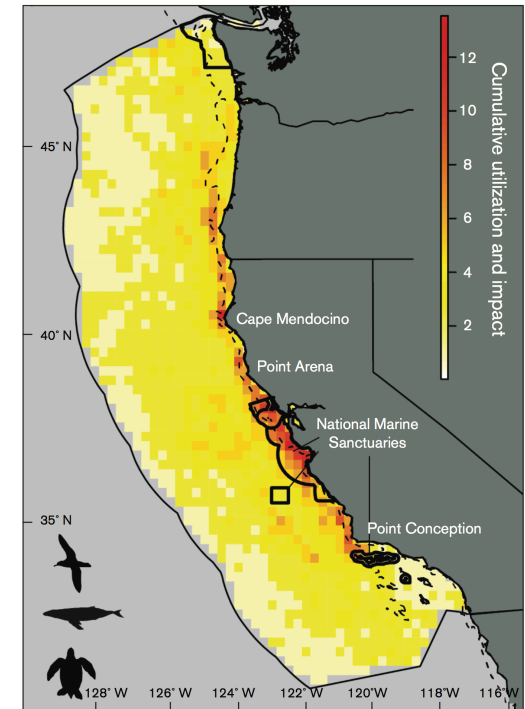
# Dynamic Ocean Management



Ryan et al. 2005



Block et al. 2011

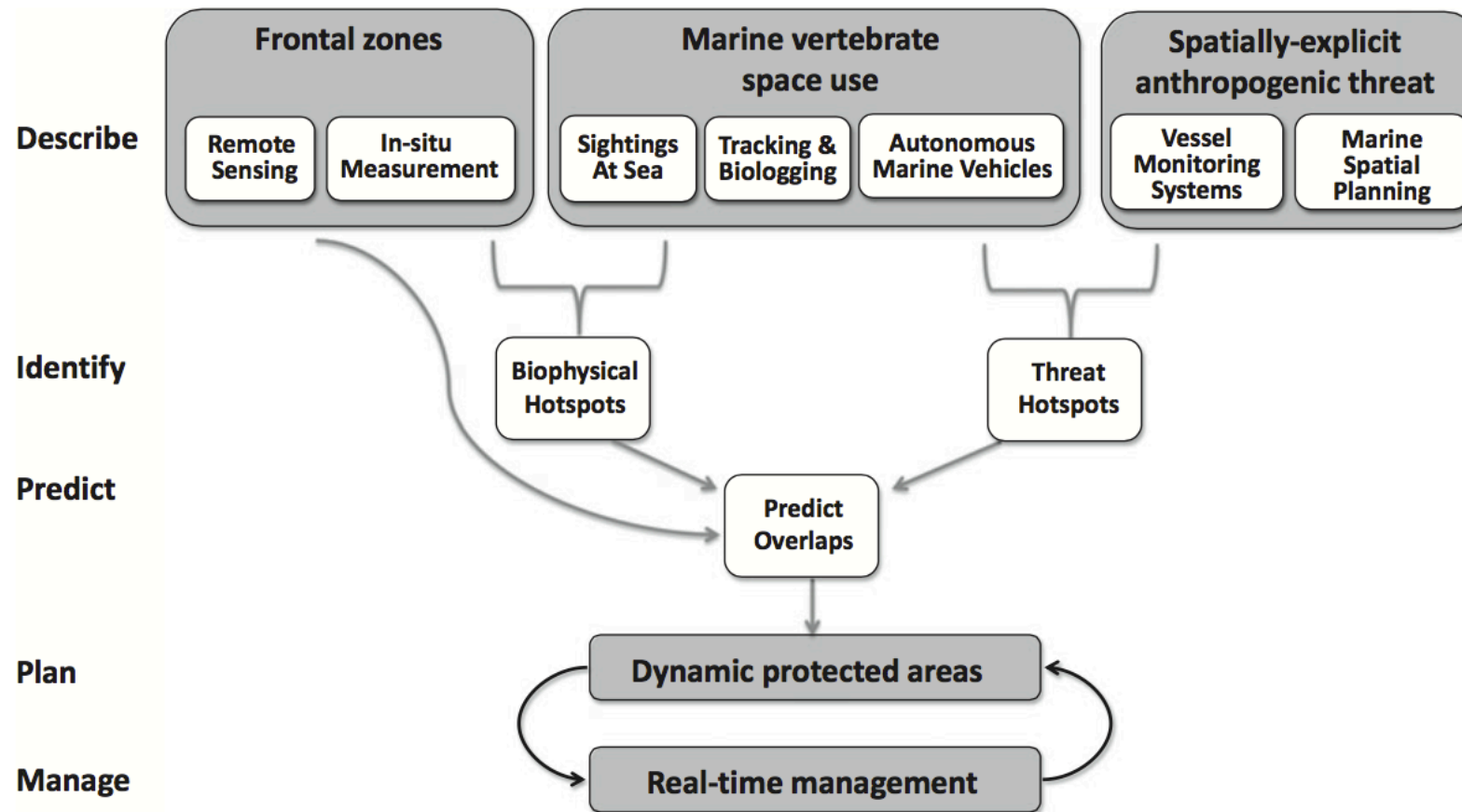


Maxwell et al. 2013

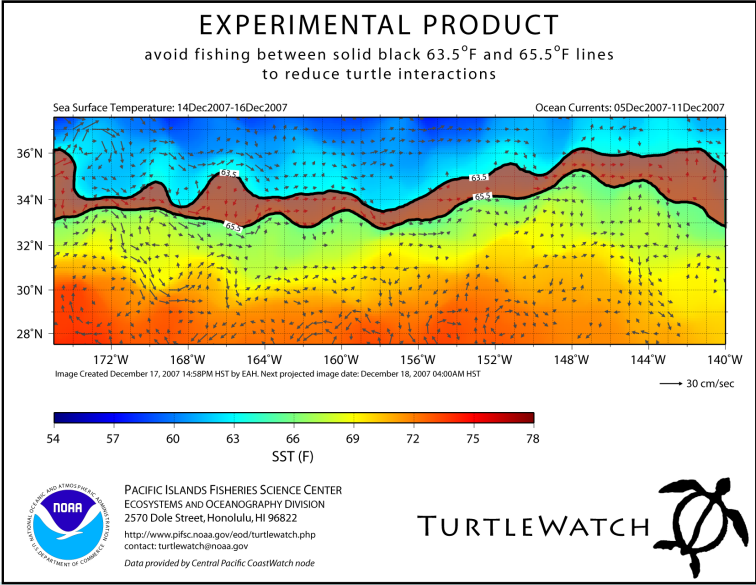
*Management that changes in space and time, at scales relevant for animal movement and human use.*

Hobday et al. 2014, Lewison et al. 2015, Maxwell et al. 2015

# Dynamic Ocean Management



Scales et al. 2014 J Appl Ecol



## TurtleWatch: a tool to aid in the bycatch reduction of loggerhead turtles *Caretta caretta* in the Hawaii-based pelagic longline fishery

Evan A. Howell<sup>1,\*</sup>, Donald R. Kobayashi<sup>1,2</sup>, Denise M. Parker<sup>1,3</sup>, George H. Balazz<sup>1</sup>, Jeffrey J. Polovina<sup>1</sup>

<sup>1</sup>Pacific Islands Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 2570 Dole Street, Honolulu, Hawaii 97822-2396, USA

<sup>2</sup>Department of Environmental Sciences, University of Technology, Sydney, Broadway, New South Wales 2007, Australia

<sup>3</sup>Joint Institute for Marine and Atmospheric Research, 1000 Pope Road, University of Hawaii, Honolulu, Hawaii 96822-2396, USA

### FISHERIES OCEANOGRAPHY

FISHERIES OCEANOGRAPHY

Fish. Oceanogr. 24:1, 57–68, 2015

## Enhancing the TurtleWatch product for leatherback sea turtles, a dynamic habitat model for ecosystem-based management

EVAN A. HOWELL<sup>1,\*</sup>, AIMEE HOOVER<sup>2,4</sup>, SCOTT R. BENSON<sup>3</sup>, HELEN BAILEY<sup>4</sup>, JEFFREY J. POLOVINA<sup>1</sup>, JEFFREY A. SEMINOFF<sup>5</sup> AND PETER H. DUTTON<sup>5</sup>

<sup>1</sup>NOAA Pacific Islands Fisheries Science Center, 1845 Wasp Blvd., Building 176 Honolulu, HI, 96818, U.S.A.

<sup>2</sup>Joint Institute for Marine and Atmospheric Research, 1000 Pope Road, Honolulu, HI, 96822, U.S.A.

<sup>3</sup>NOAA Southwest Fisheries Science Center, 7544 Sandholdt Road, Moss Landing, CA, 95039, U.S.A.

<sup>4</sup>Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, 146 Williams Street, Solomons, MD, 20688, U.S.A.

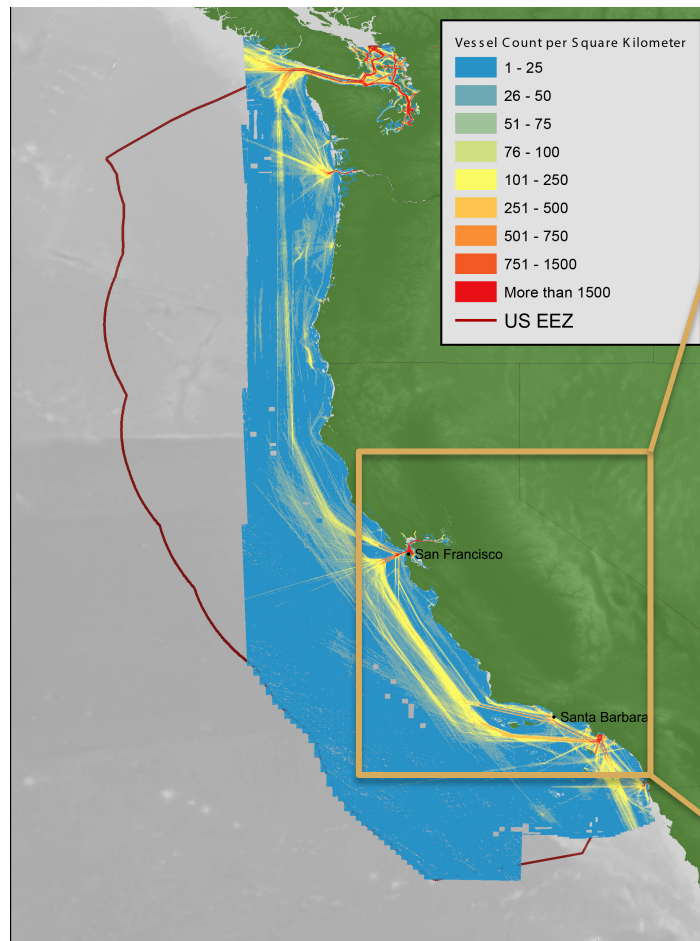
<sup>5</sup>NOAA Southwest Fisheries Science Center, 8901 La Jolla Shores Dr., La Jolla, CA, 92037, U.S.A.

centered at 17.2° and 22.9°C, occupied by leatherbacks on fishing grounds of the Hawaii-based swordfish fishery. This new information was used to expand the TurtleWatch product to provide managers and industry near real-time habitat information for both loggerheads and leatherbacks. The updated TurtleWatch product provides a tool for dynamic management of the Hawaii-based shallow-set fishery to aid in the bycatch reduction of both species. Updating the management strategy to dynamically adapt to shifts in multi-species habitat use through time is a step towards an ecosystem-based approach to fisheries management in pelagic ecosystems.

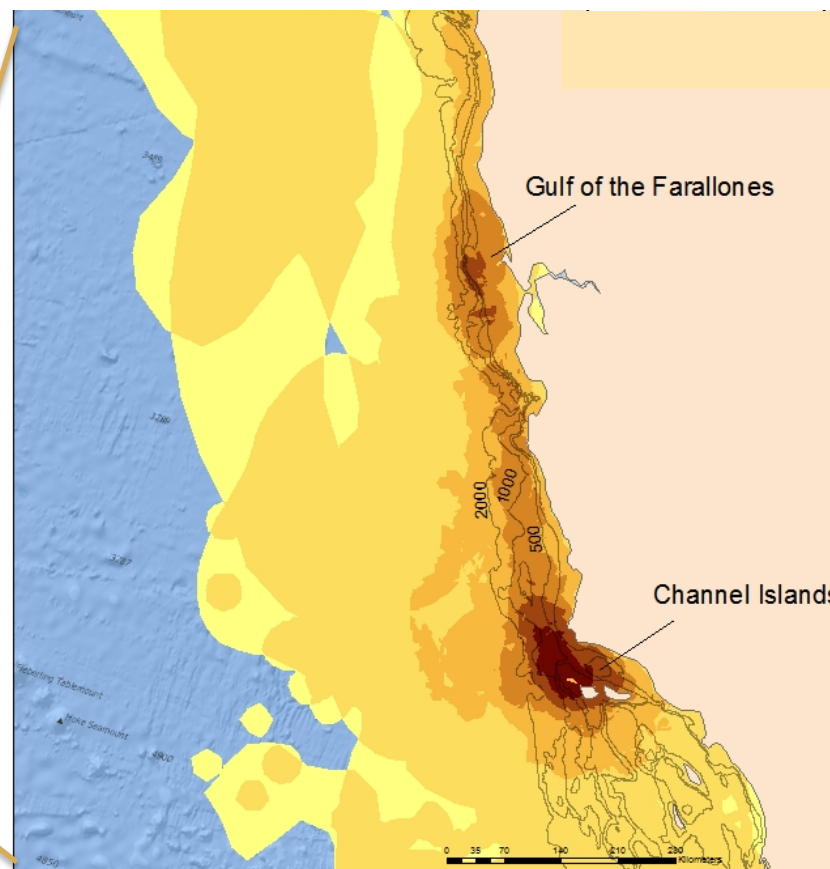
**Key words:** Central North Pacific, dynamic management, fisheries, leatherback sea turtles, sea surface temperature, swordfish

### ABSTRACT

# Shipping and blue whale hotspots



Hazen et al. in review

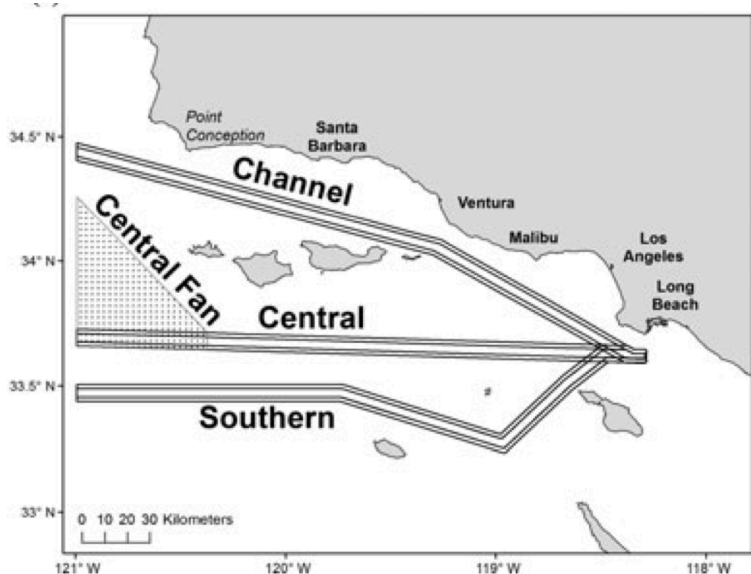


**Blue whales have similar hotspots (1994-2008). From Irvine et al. 2014**

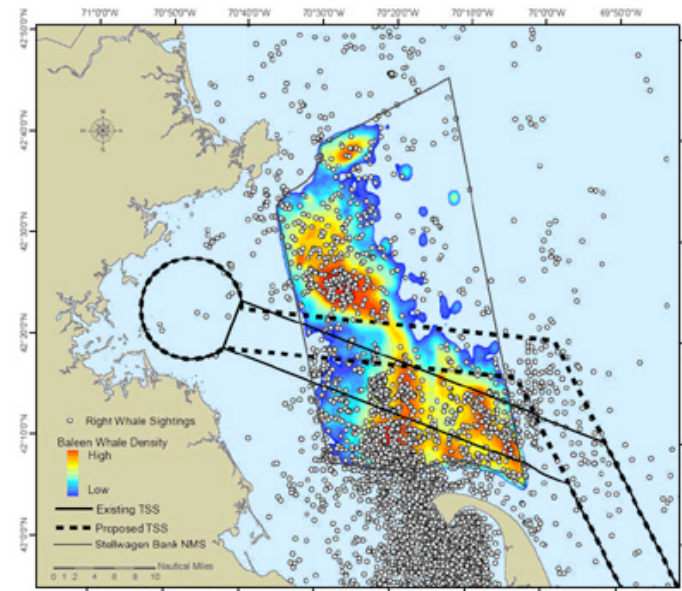
- High spatial overlap between shipping intensity and blue whale hotspots
- Opportunity for finer temporal management?

# WhaleWatch - Objective

- Use satellite telemetry and oceanographic data to develop near-real time (8-day to monthly) habitat models for blue whales in the California Current System.
- This will assist management efforts to mitigate against human impacts, such as ship strikes and entanglements. Working closely with NOAA/NMFS West Coast Regional Office.

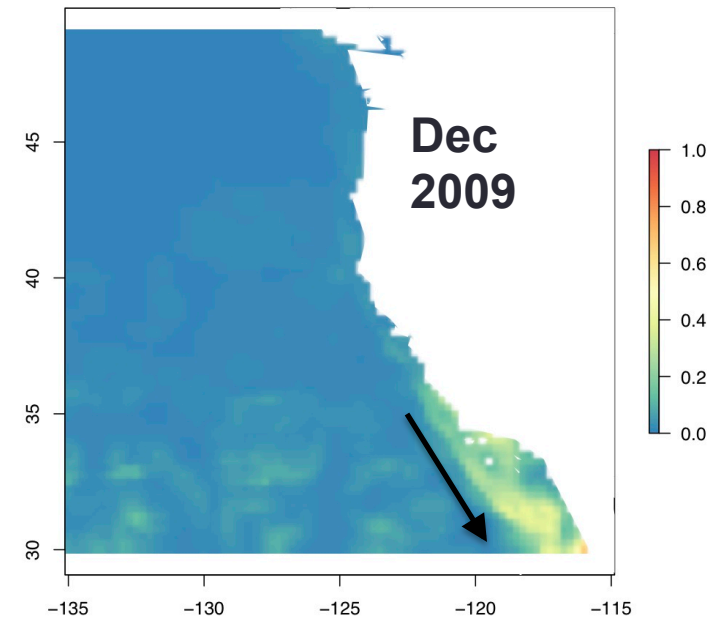
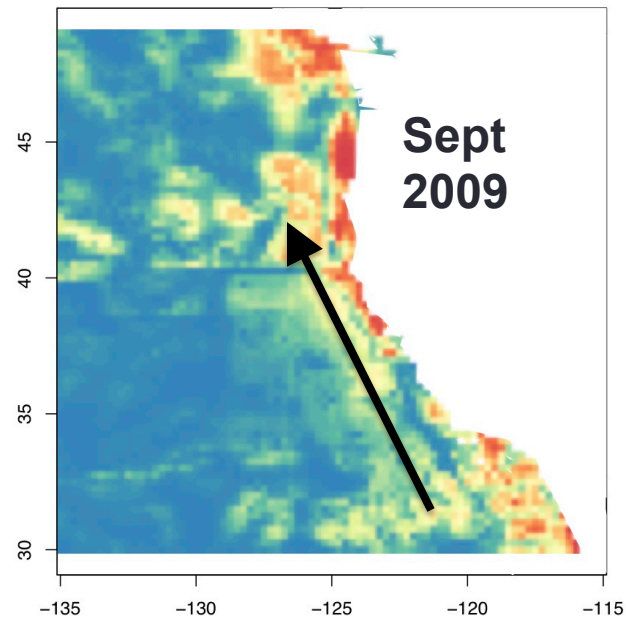
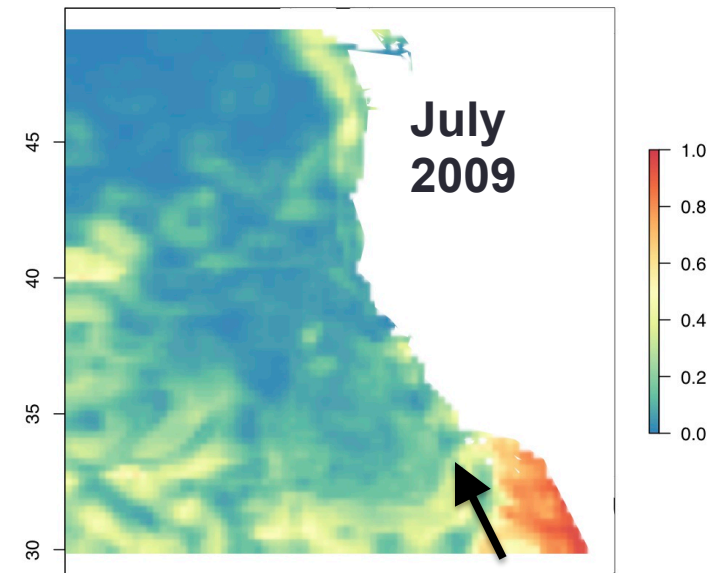
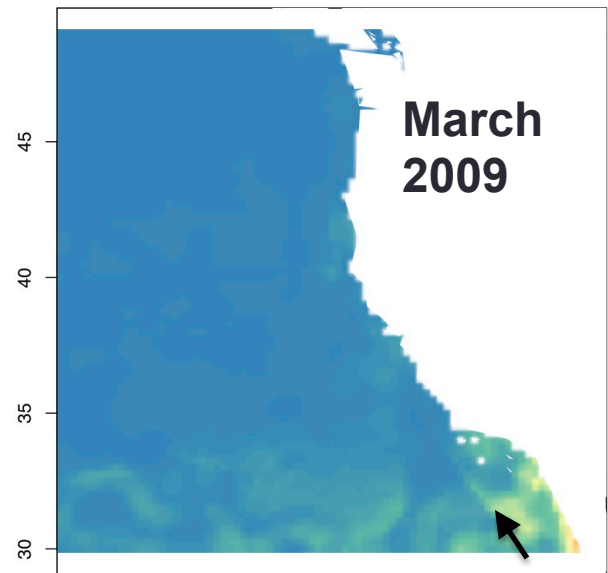
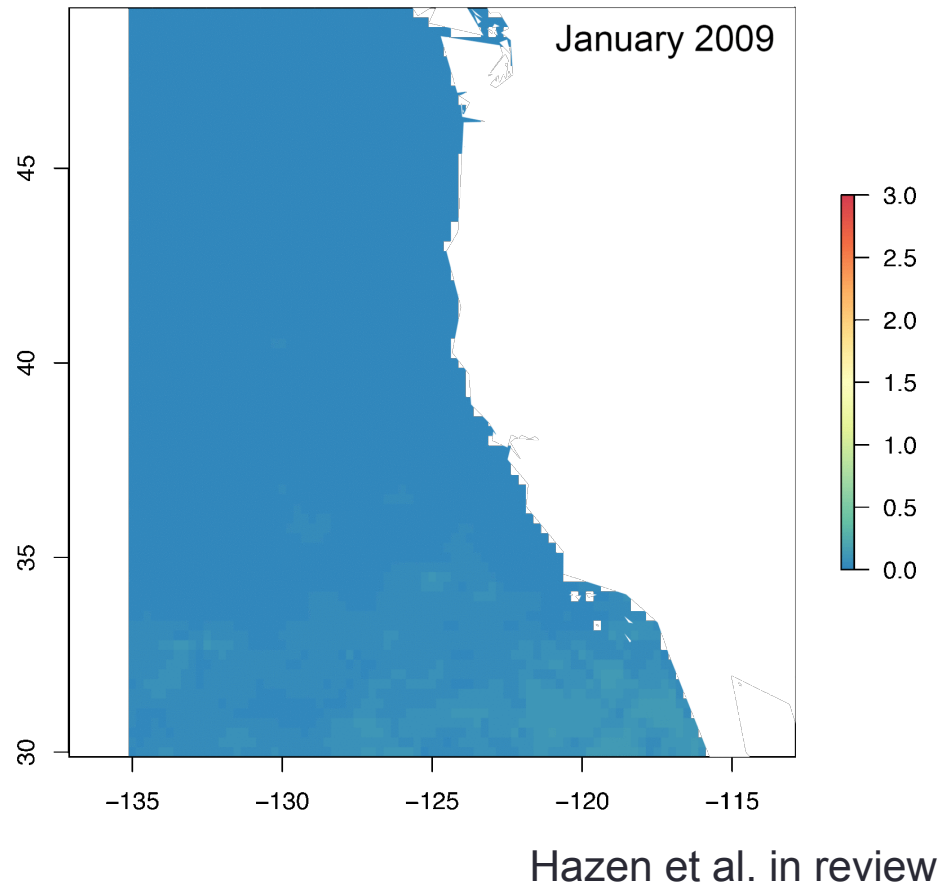


Redfern  
et al.  
2013

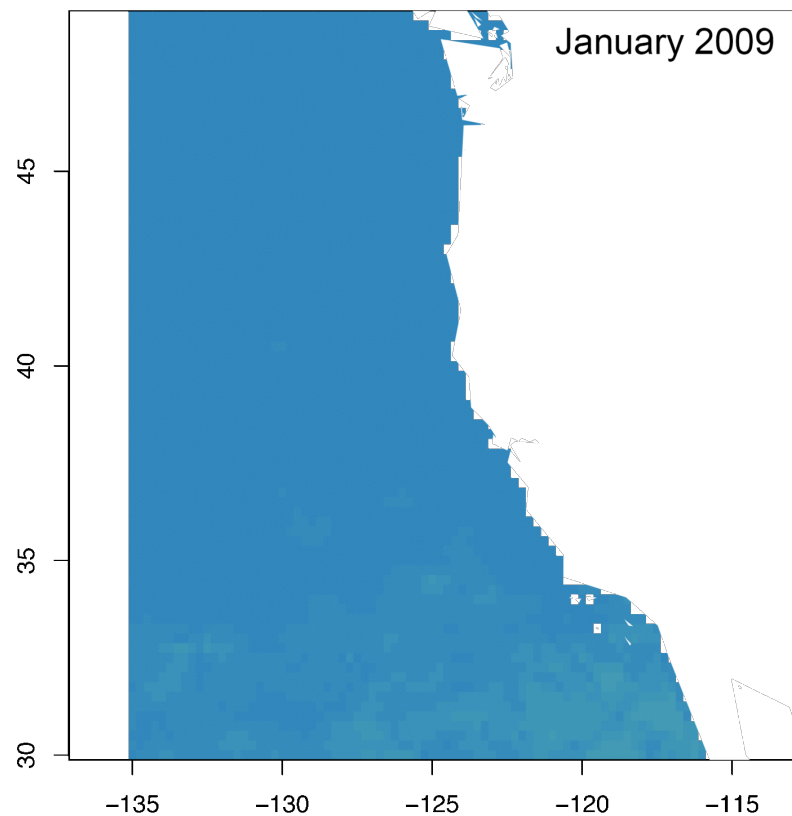


Wiley  
et al.  
2011

# Seasonal Predictions




# WhaleWatch



<http://www.westcoast.fisheries.noaa.gov/whalewatch/index.html>


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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

West Coast Region



WHALEWATCH

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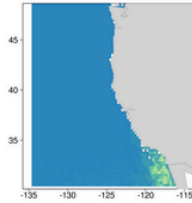
## WhaleWatch

**WhaleWatch** is a NASA-funded project to help reduce human impacts on whales by providing near real-time information on where they occur and hence where whales may be most at risk from threats, such as ship strikes, entanglements and loud underwater sounds. These predictions were developed from habitat-based models of whale occurrence that combine satellite tracking of whales with information on the environment.

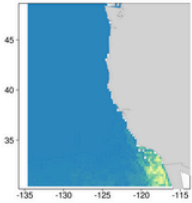
**This month's predictions for Blue Whales (*Balaenoptera musculus*) off the U.S. West Coast:**

1-Feb-2016 - 1-Mar-2016

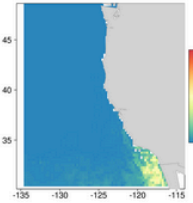
Lower



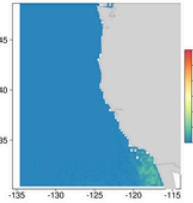
Average



Upper



Average



Values are per 25 x 25 km (approximately 13 x 13 nmile). Red colors represent higher occurrence and blue lower values. It should be noted that these predictions are only estimates based on the models developed from historical data and do not represent actual recorded sightings or current densities. In this version, the model predictions are based on monthly products of the environmental data.

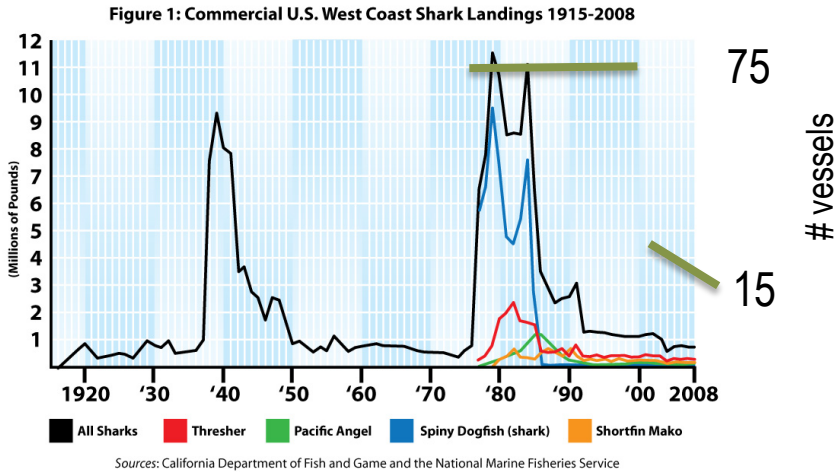
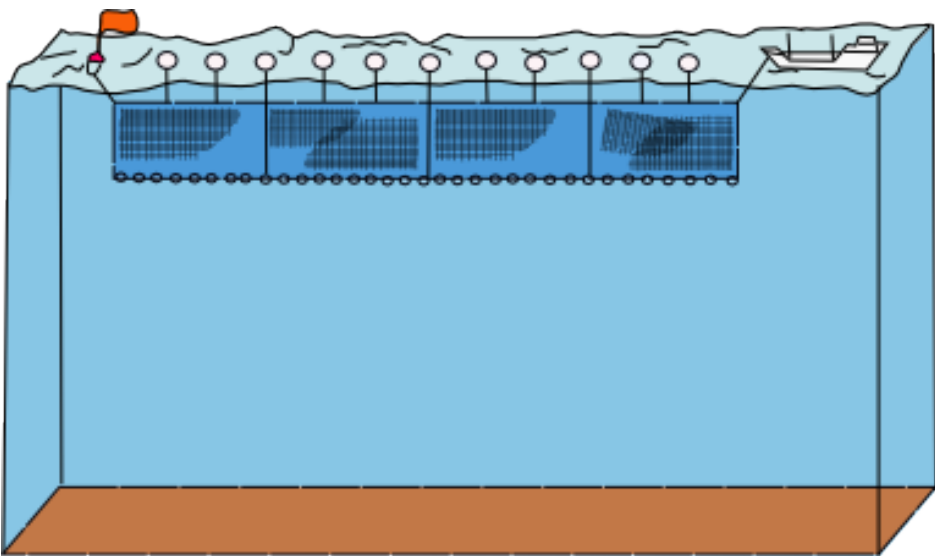
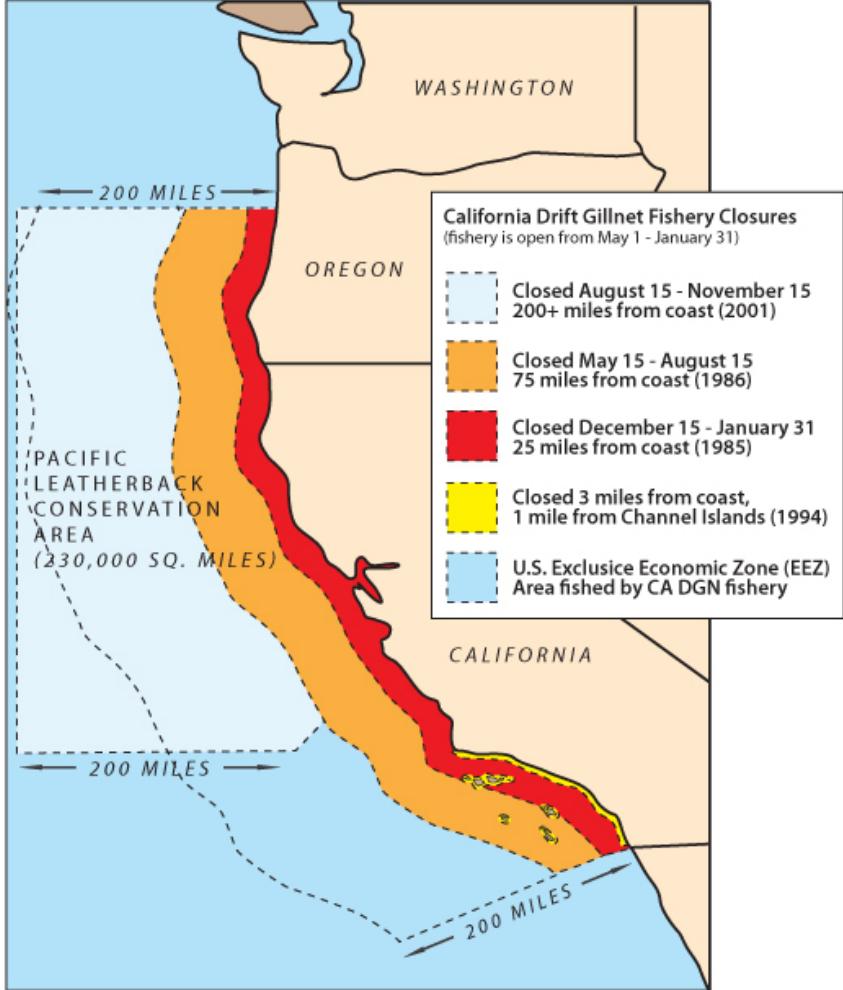
This research has been conducted by a multi-institutional team of academic groups and governmental organizations led by Helen Bailey ([University of Maryland Center for Environmental Science](#)) and in collaboration with the NOAA/NMFS West Coast Regional Office. The satellite telemetry data on whales were collected by Bruce Mate and colleagues ([Oregon State University](#)), geo-spatial distribution by Ladd Irvine (OSU), habitat modeling by Daniel Palacios (OSU), Elliott Hazen, Steven Bogard, Karin Forney ([NOAA/NMFS Southwest Fisheries Science Center](#)), and the web tool created by Evan Howell and Aimee Hoover ([NOAA/NMFS Pacific Islands Fisheries Science Center](#)).

Funding for this project was provided under the interagency NASA, USGS, National Park Service, US Fish and Wildlife Service, Smithsonian Institution Climate and Biological Response program, Grant Number NNX11AP71G. Funding for whale tagging was provided by the [Office of Naval Research](#), the [Marine Mammal Institute at OSU](#), and the Sloan, Packard and Moore Foundations to the [Tagging of Pacific Predators](#) Program.

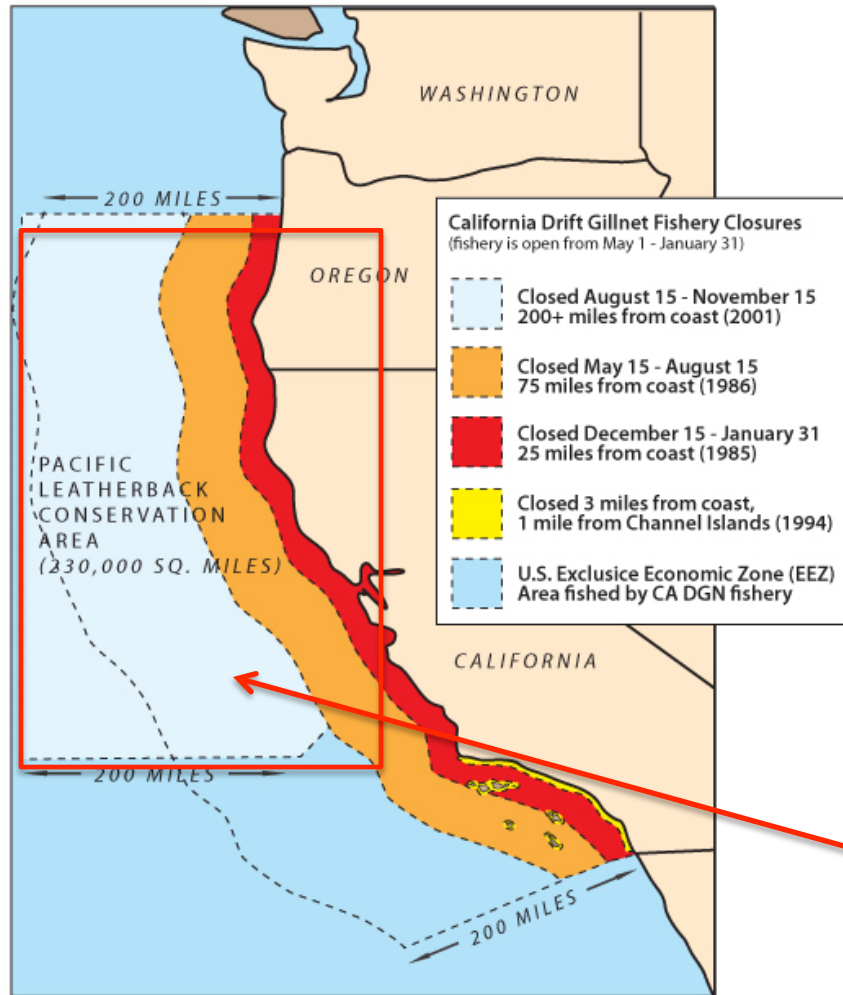
For more information on **WhaleWatch** please contact [Helen Bailey](#).

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 11

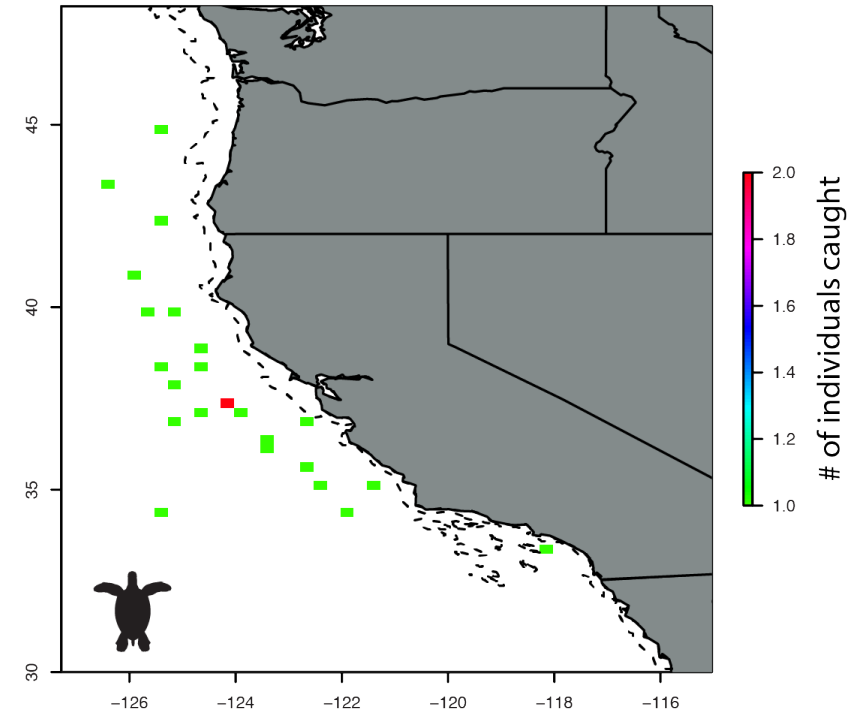
# California Drift Gillnet Fishery



# California Drift Gillnet Fishery



## Bycatch: Leatherback sea turtles



Large seasonal closure put into place in 2001 to protect leatherbacks (<1000 left)....

....leatherback bycatch dropped to **zero** since closure but large **economic cost**

# EcoCast

Integrating with The Nature Conservancy's eCatch platform to serve and collect fishery data

Models are updated in real-time as satellite data come in and can easily be downloaded on a mobile platform.

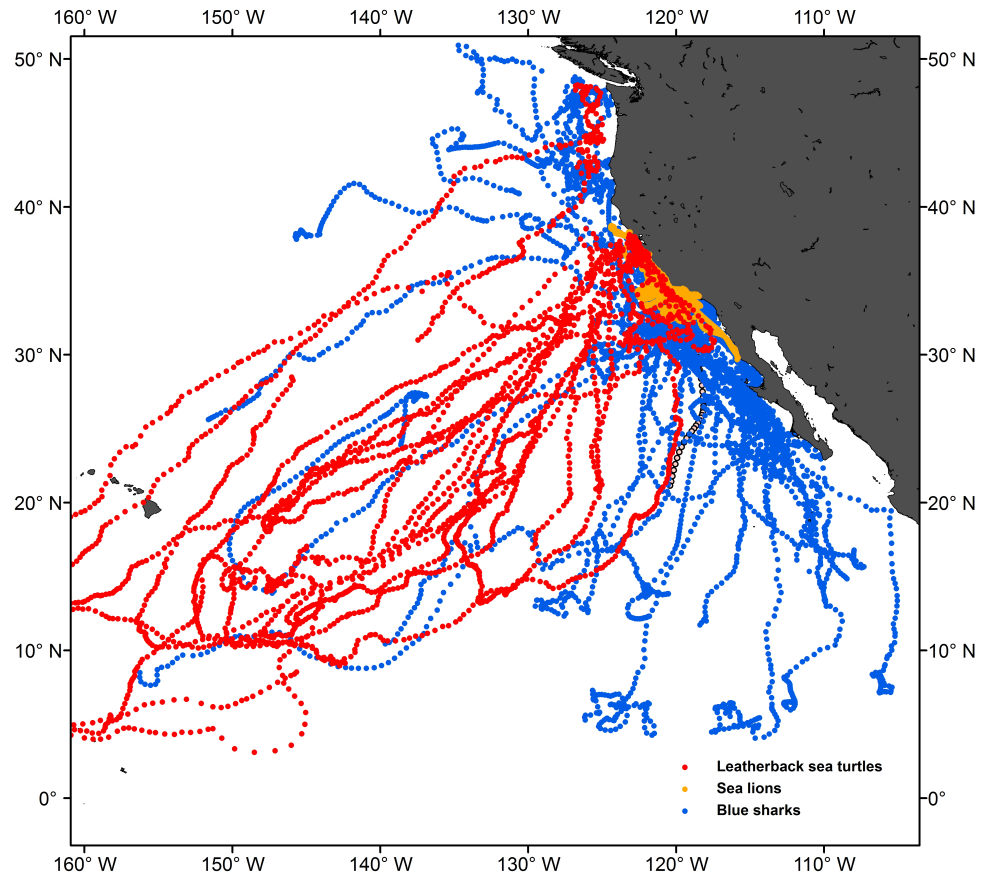
Models to include: hard cap species, risk weightings, seasonal forecasting.



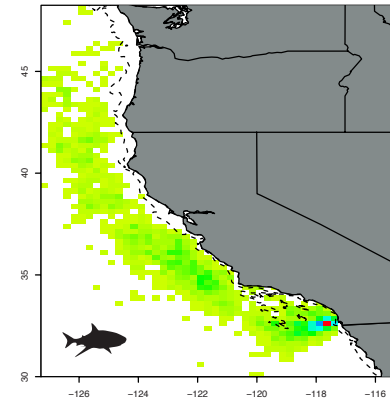
# California Drift Gillnet Fishery

Data Types:

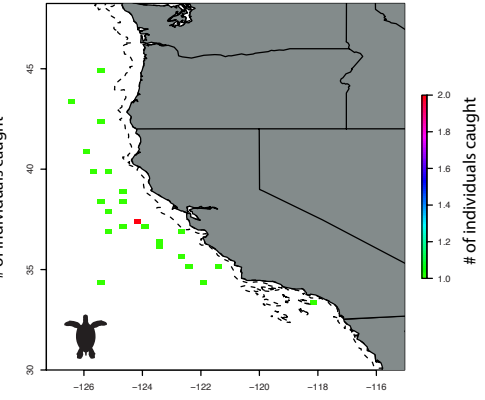
Satellite tracking data + NOAA  
Fishery observer data marine mammal  
survey data



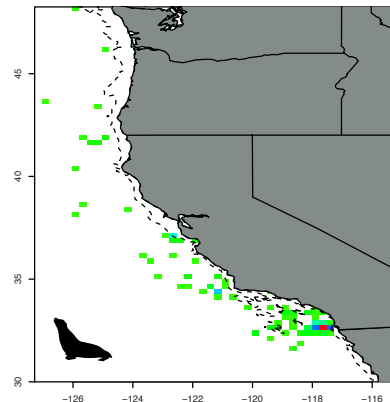
**Bycatch:** Blue sharks



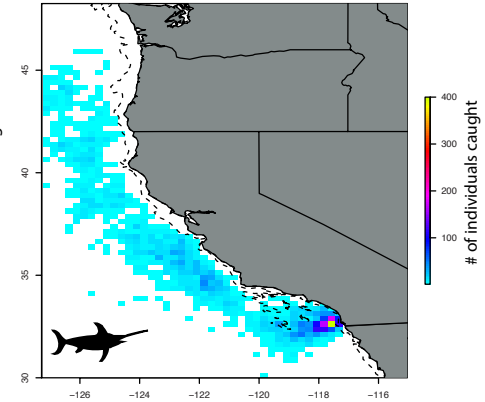
**Bycatch:** Leatherback sea turtles



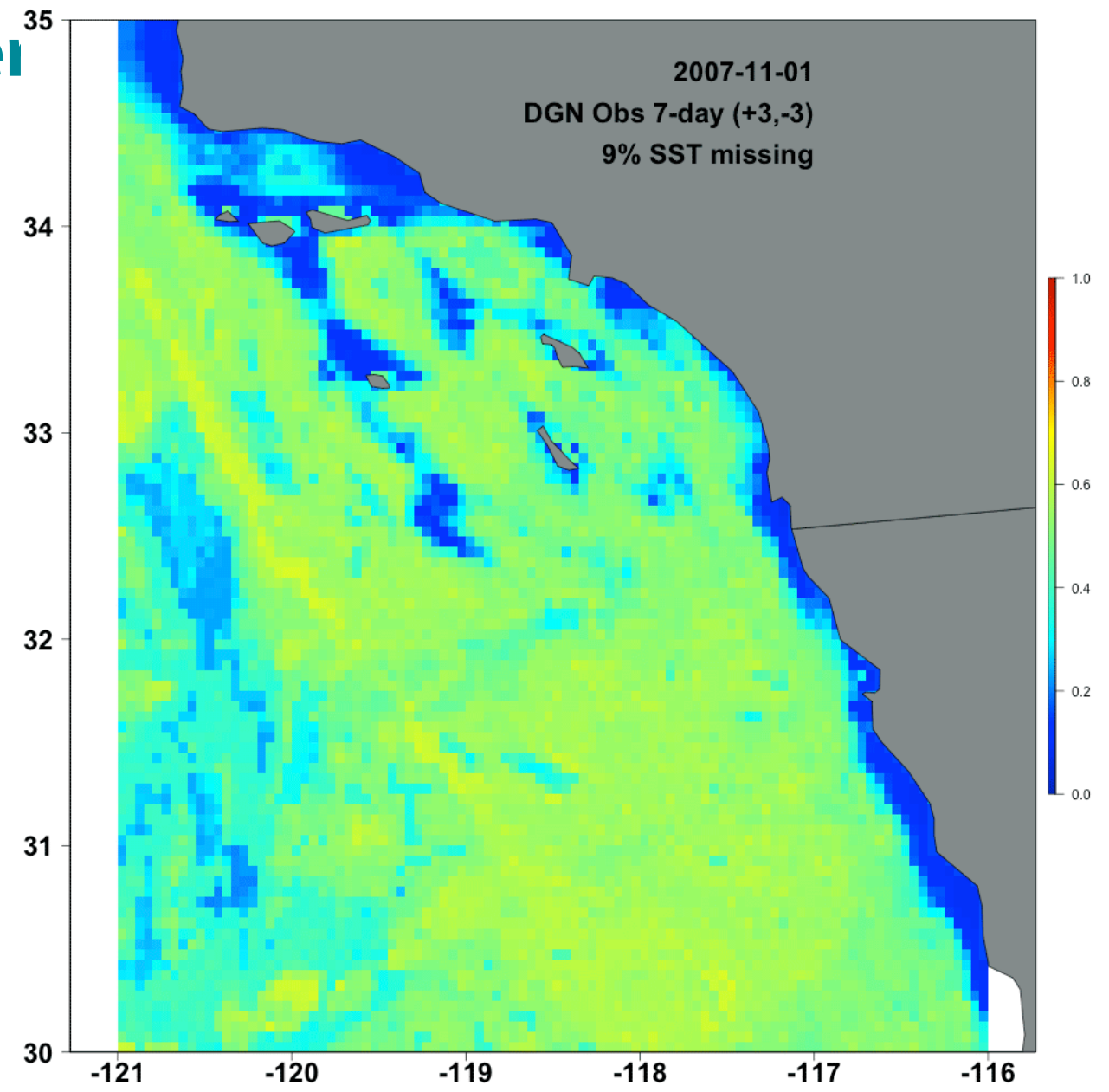
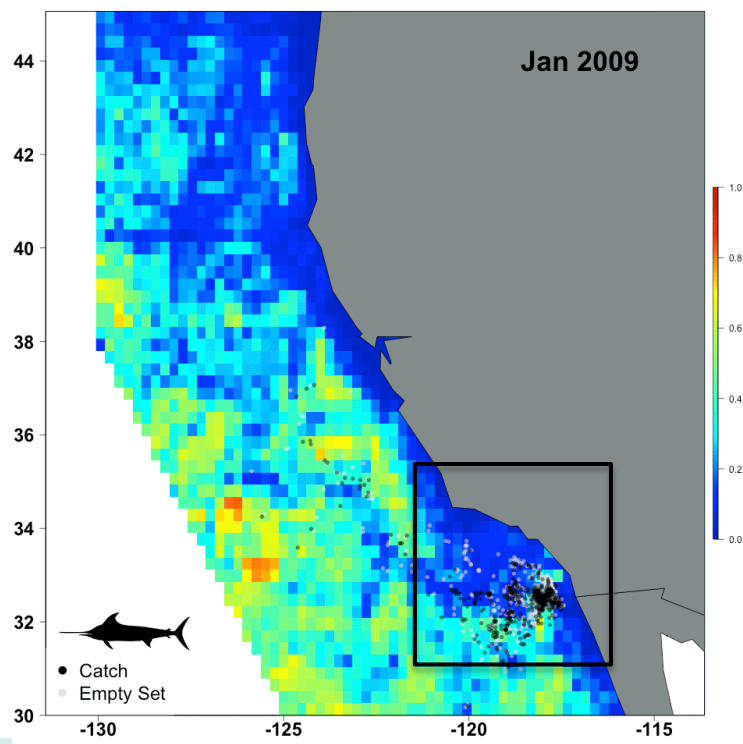
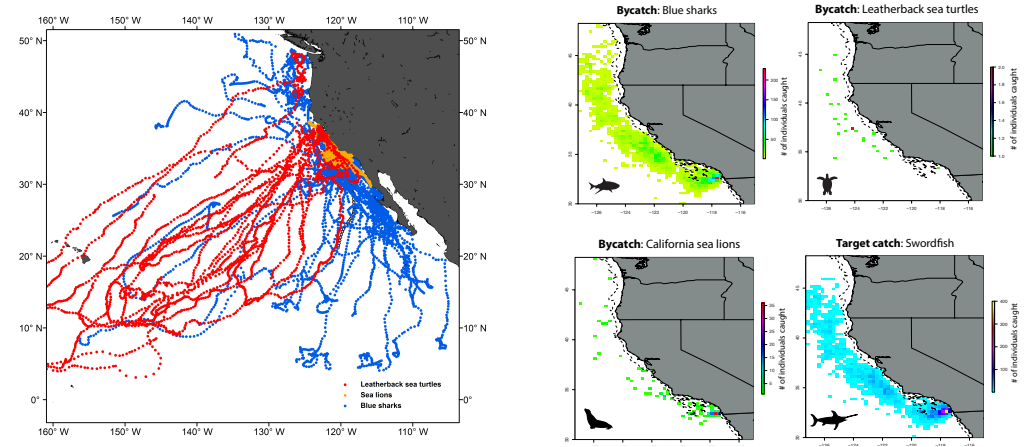
**Bycatch:** California sea lions



**Target catch:** Swordfish



# California Drift Gillnet Fishery



# Dynamic Ocean Management

- Strengths:
  - Win-win of DOM (Dunn et al. 2016 *PNAS*)

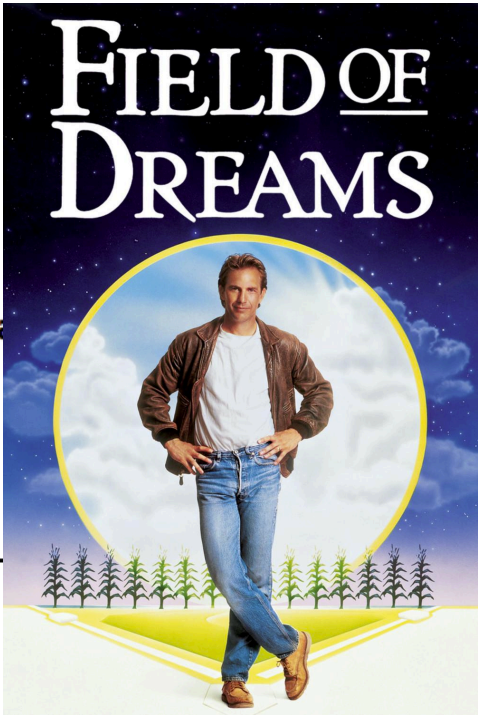


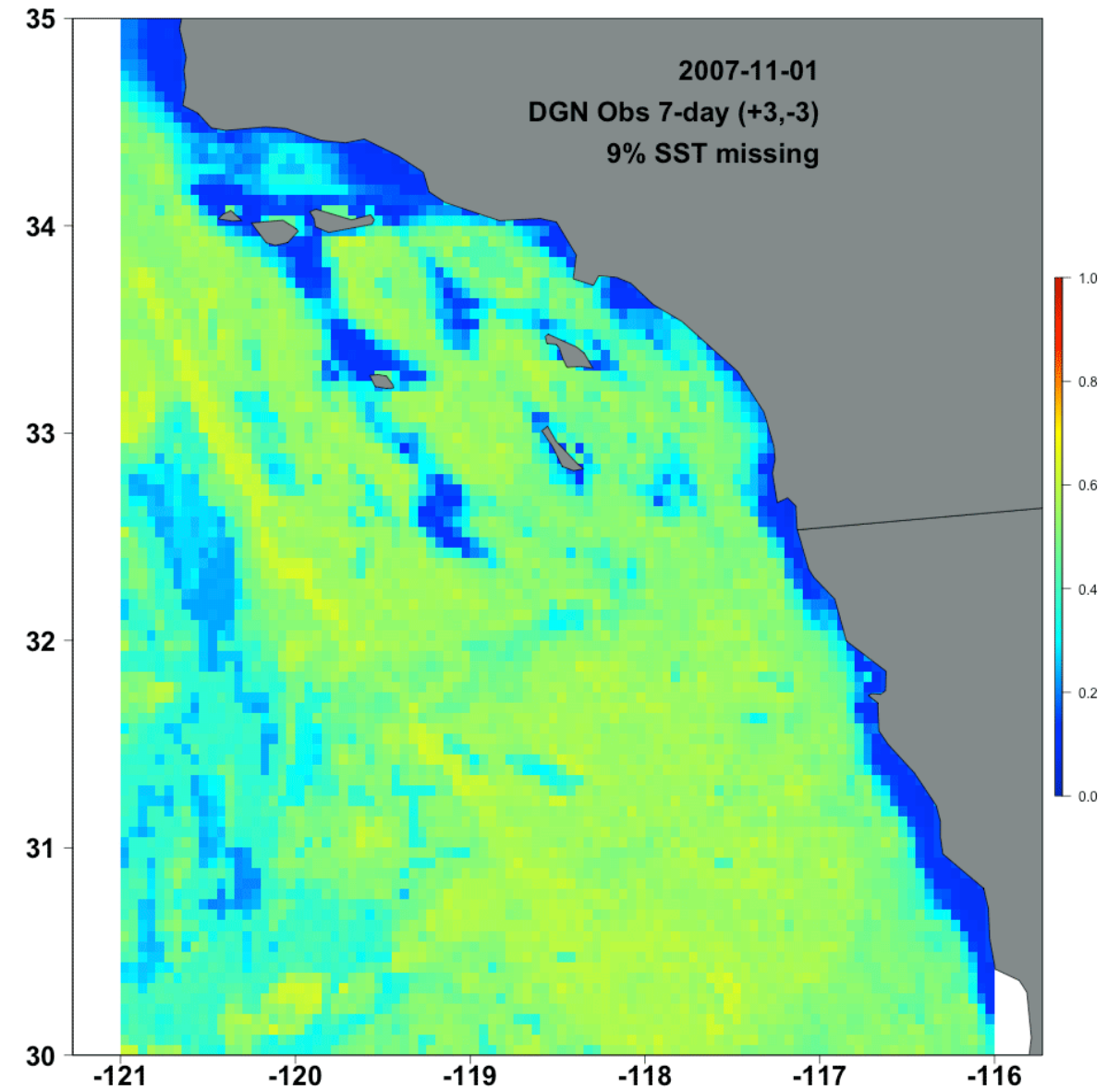
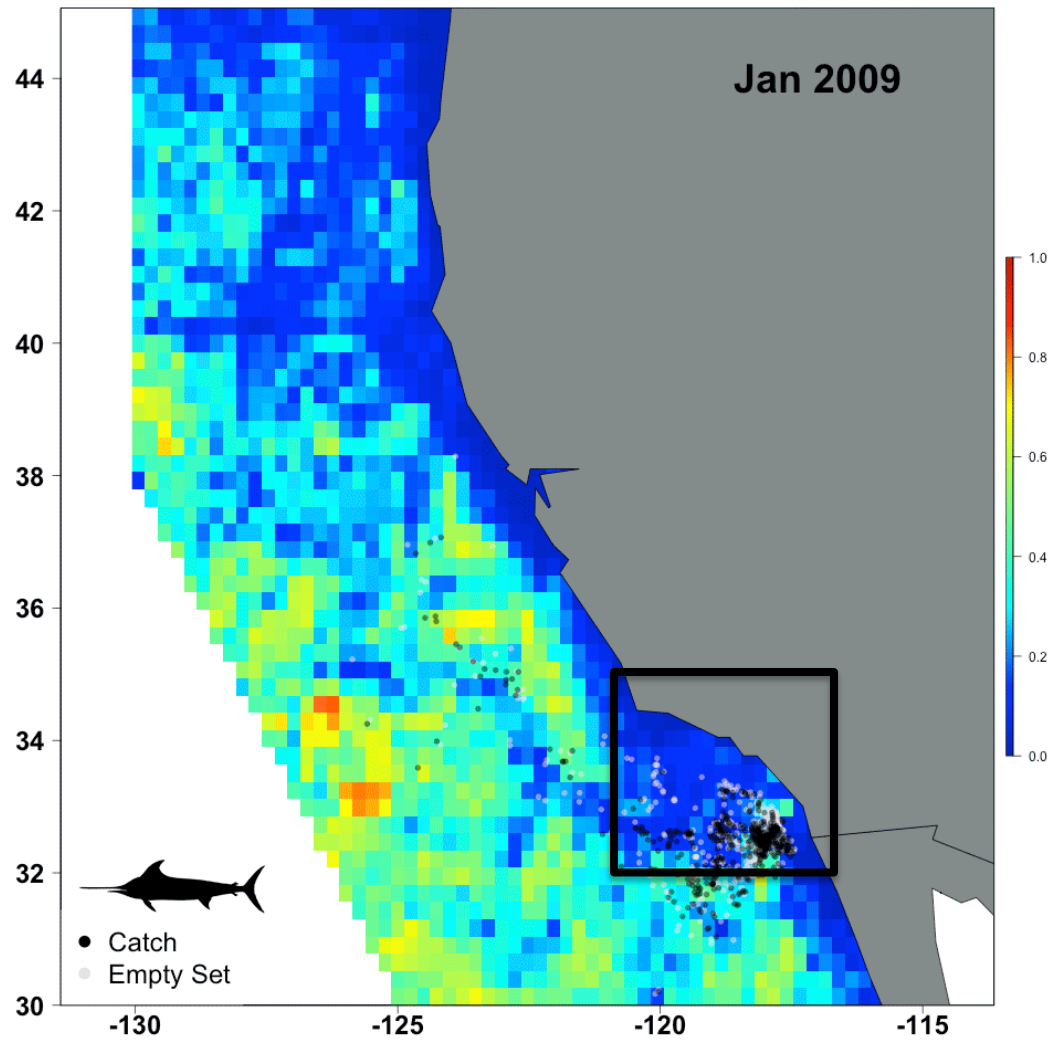
Table 1. Results from the simulation of six different closures type spanning a range

Closure type	BLM or weight threshold, lb	Percent bycatch reduction	Percent target catch affected	Bycatch reduction efficiency	No. of closures	Area of closure resolution		
Move-on rules	NA	62.17	8.57	7.25	48	19.63	1	2.97
Daily grid-based closures	10	61.66	7.39	3.55	30	50 / 2600	1	3.18
Weekly grid-based closures	10	61.66	18.27	3.37	30	50	7	4.02
Monthly grid-based closures	10	61.66	18.27	3.37	30	50	7	4.02
Annual time-area closures	0.001	68.72	37.47	1.83	2	100	365	4.86
Monthly total closures	NA	68.54	43.28	1.58	4	2,600	30	5.49

More bycatch reduction, less effect on target catch, less area closed

BLM, boundary length modifier (see [Supporting Information](#)); SUM, spatiotemporal utility metric that provides a summary across all metrics.

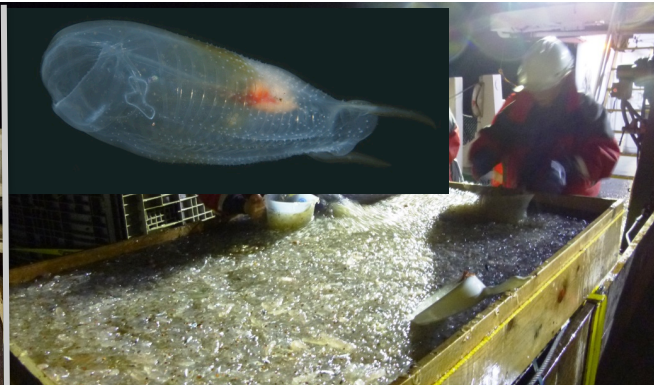
# Questions?



# Local anomalies in species distributions, mixing of assemblages and survival:



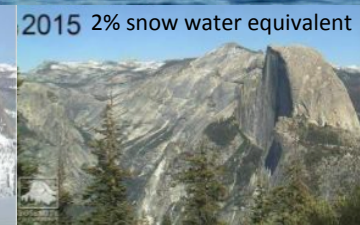
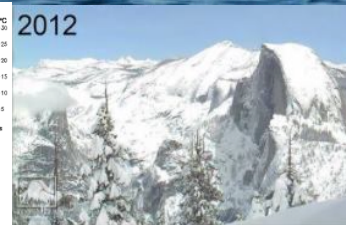
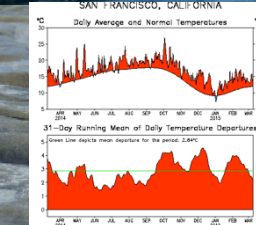
Shortbelly rockfish young, Pt. Sur



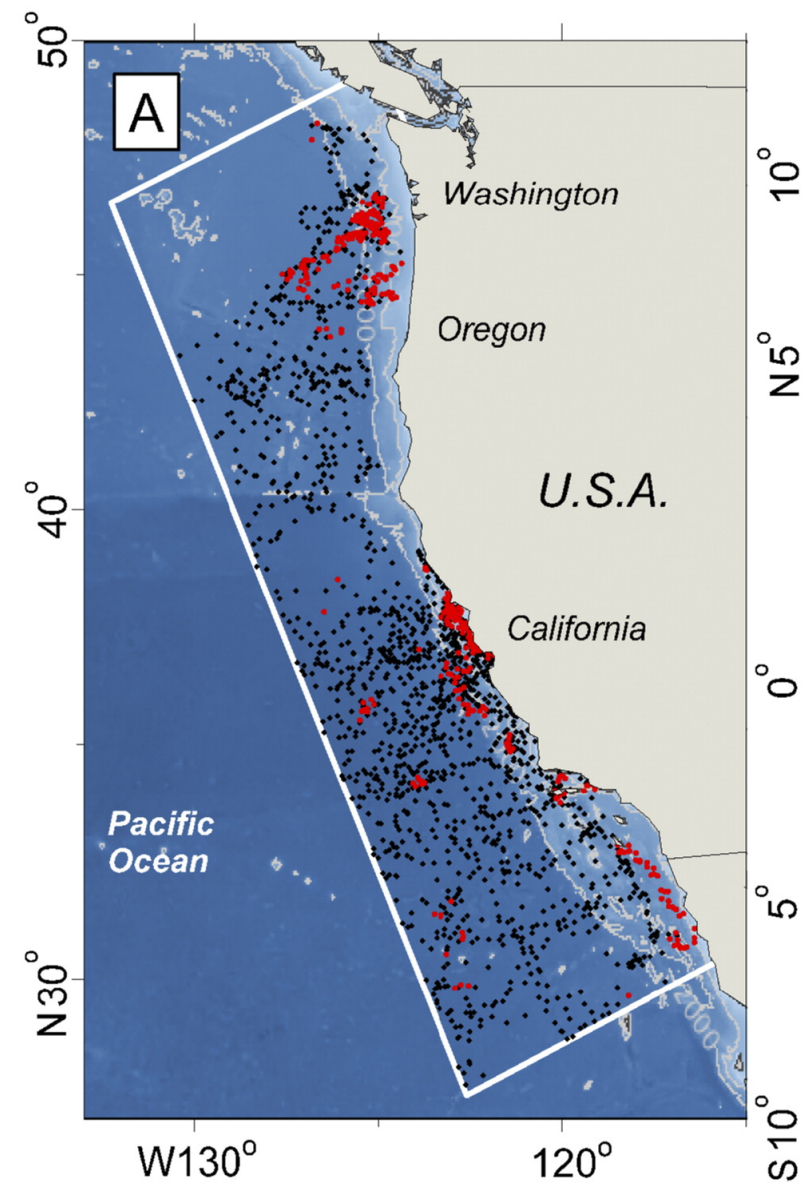
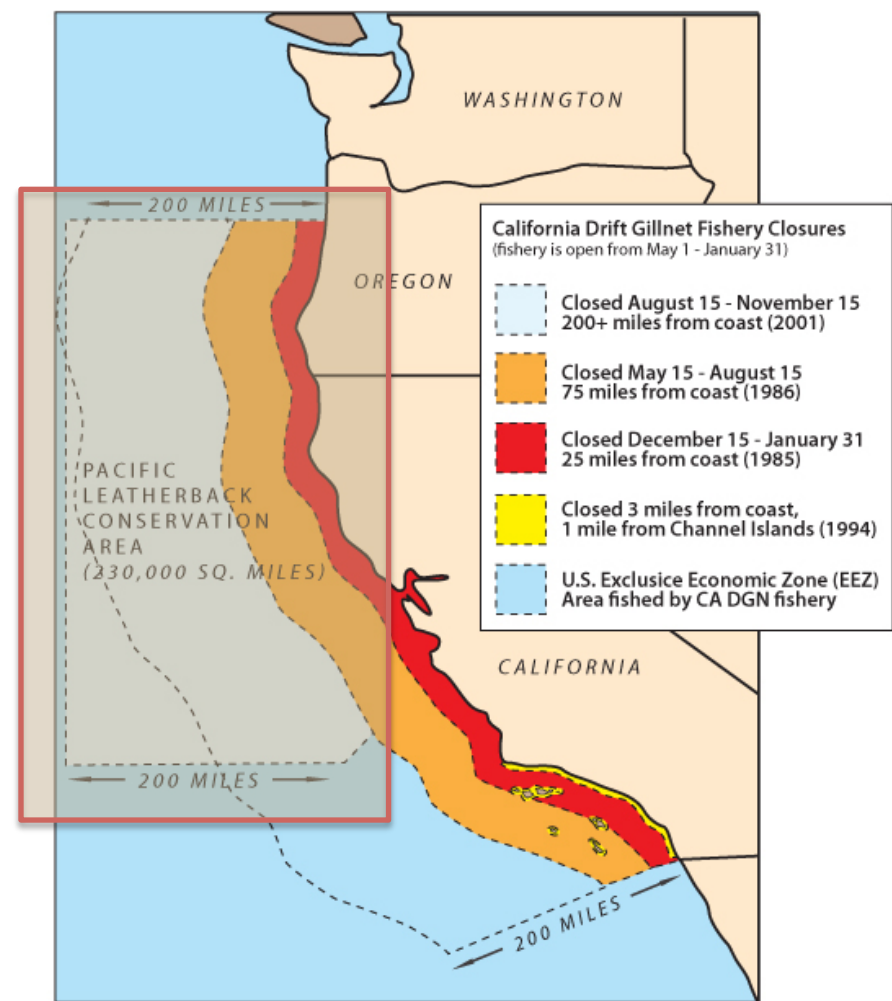
Salps and pyrosomes, Pt. Piedras Blancas



Pelagic red crabs, San Nicolas Isl.

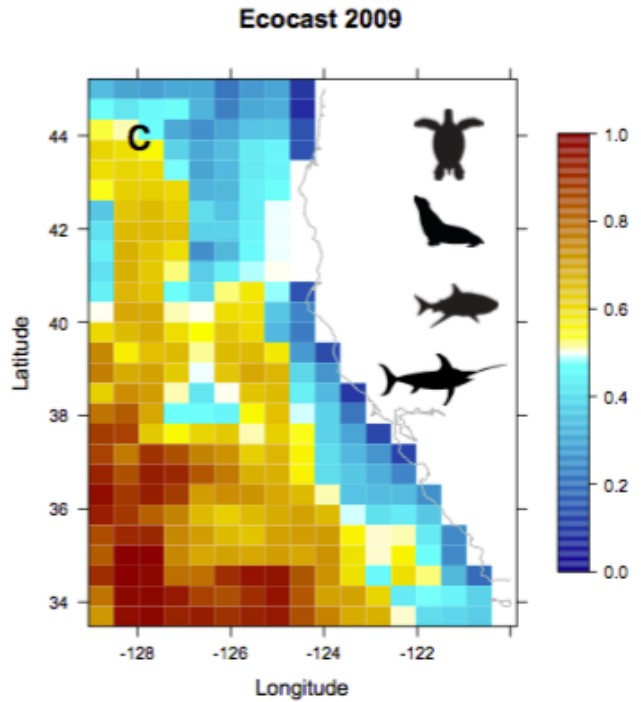
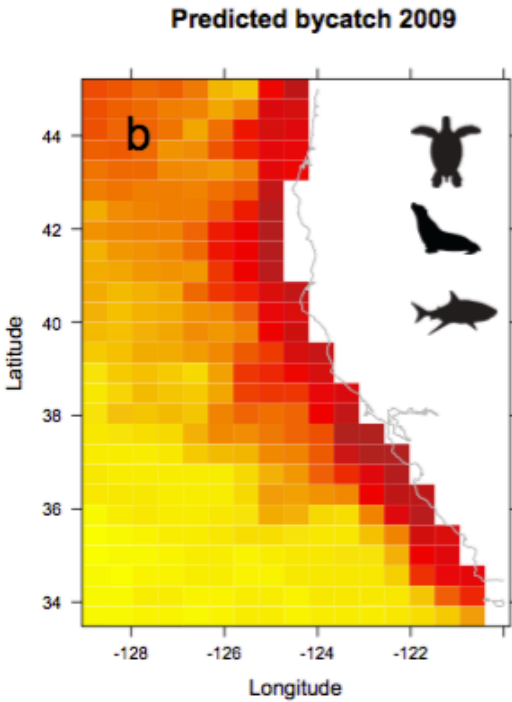
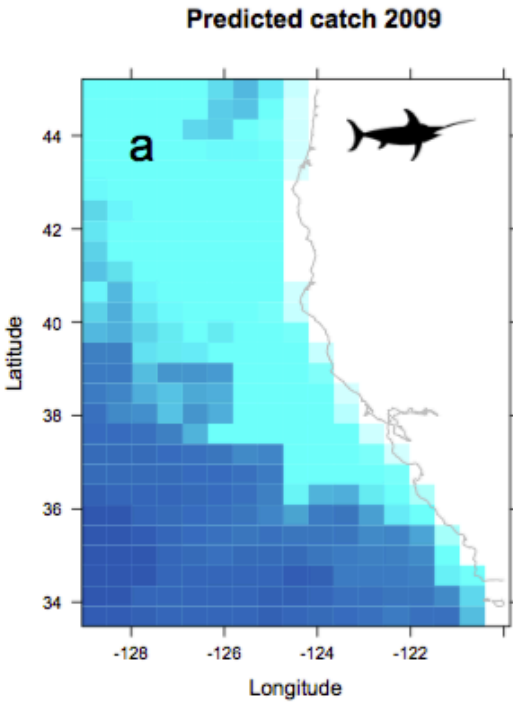
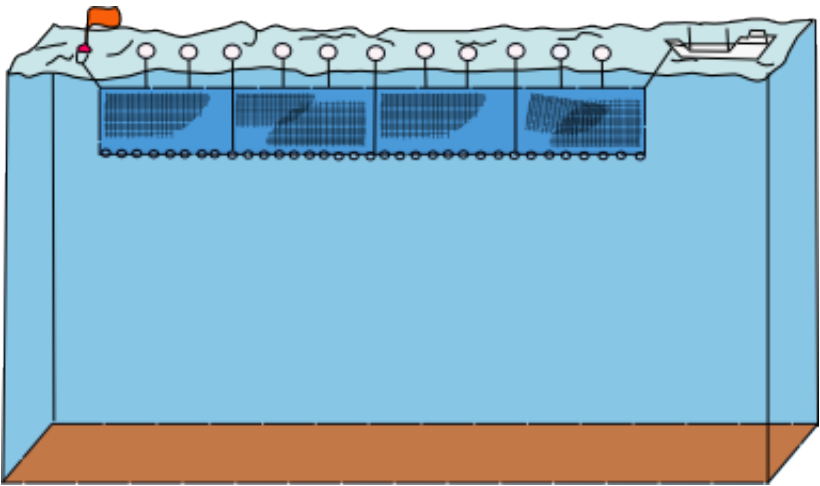
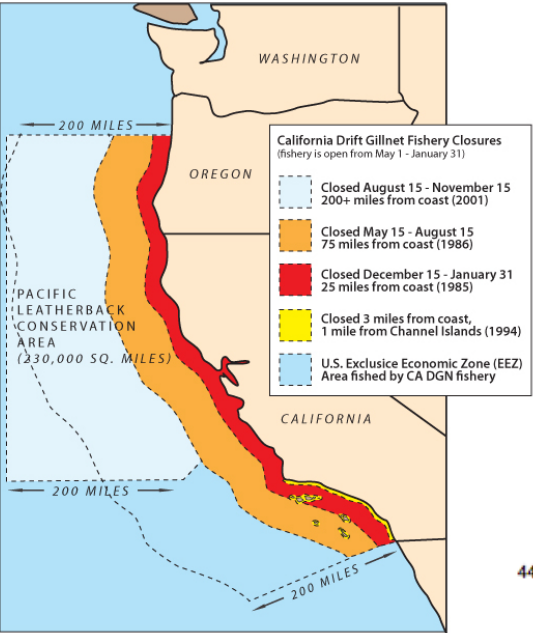


# California Drift Gillnet Fishery

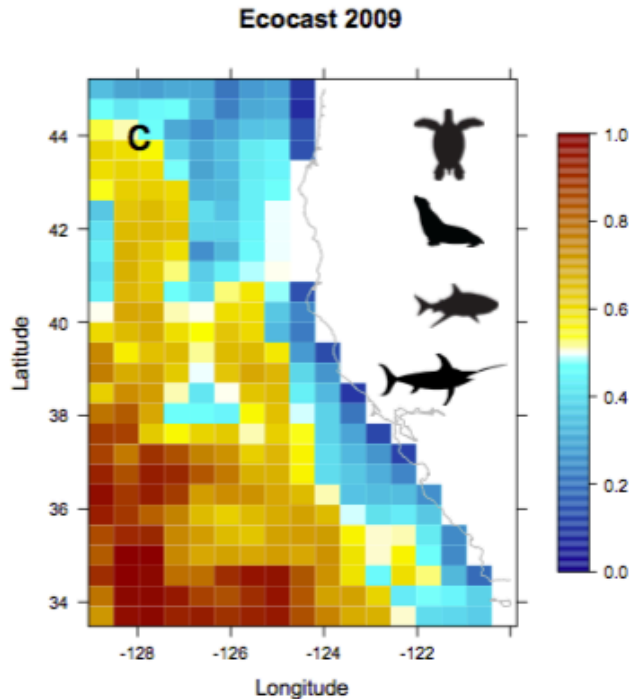
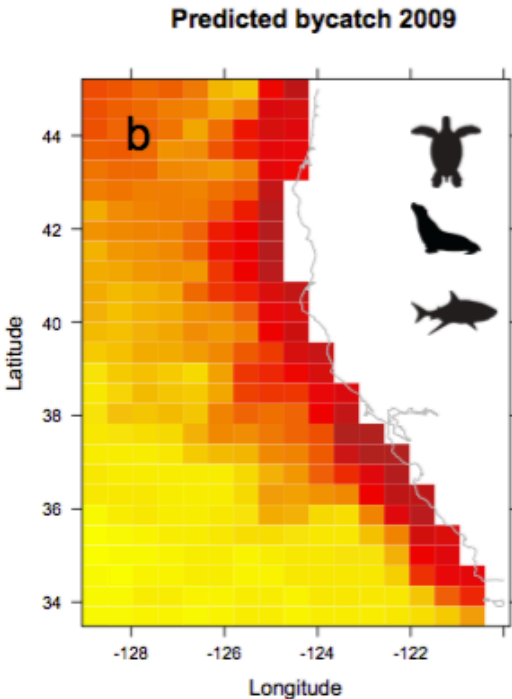
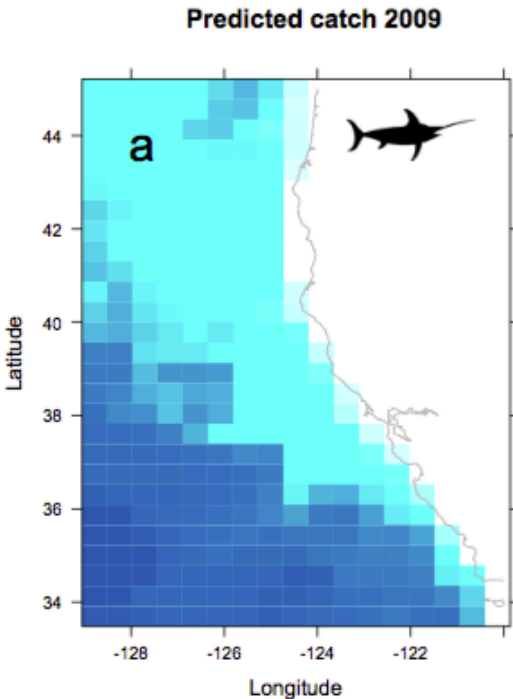
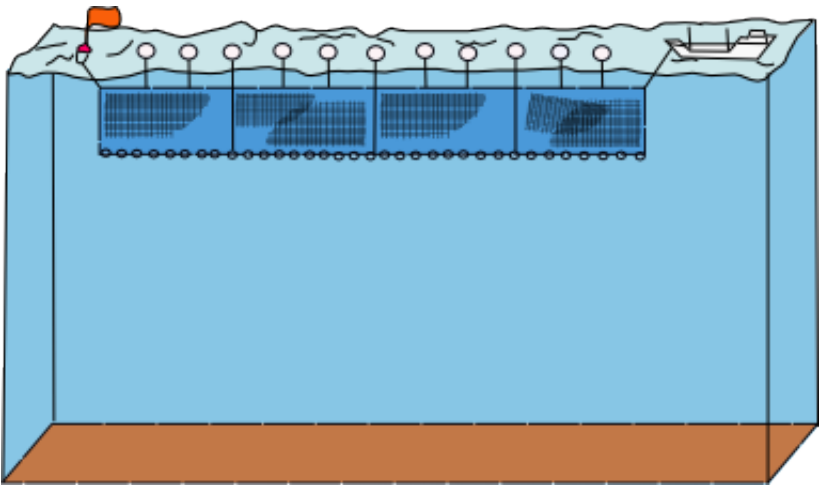
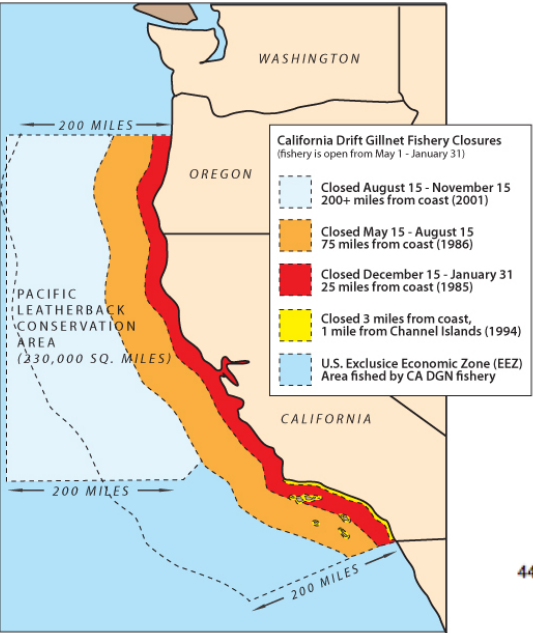


Satellite tracks from Benson et al 2011 | *Ecosphere*

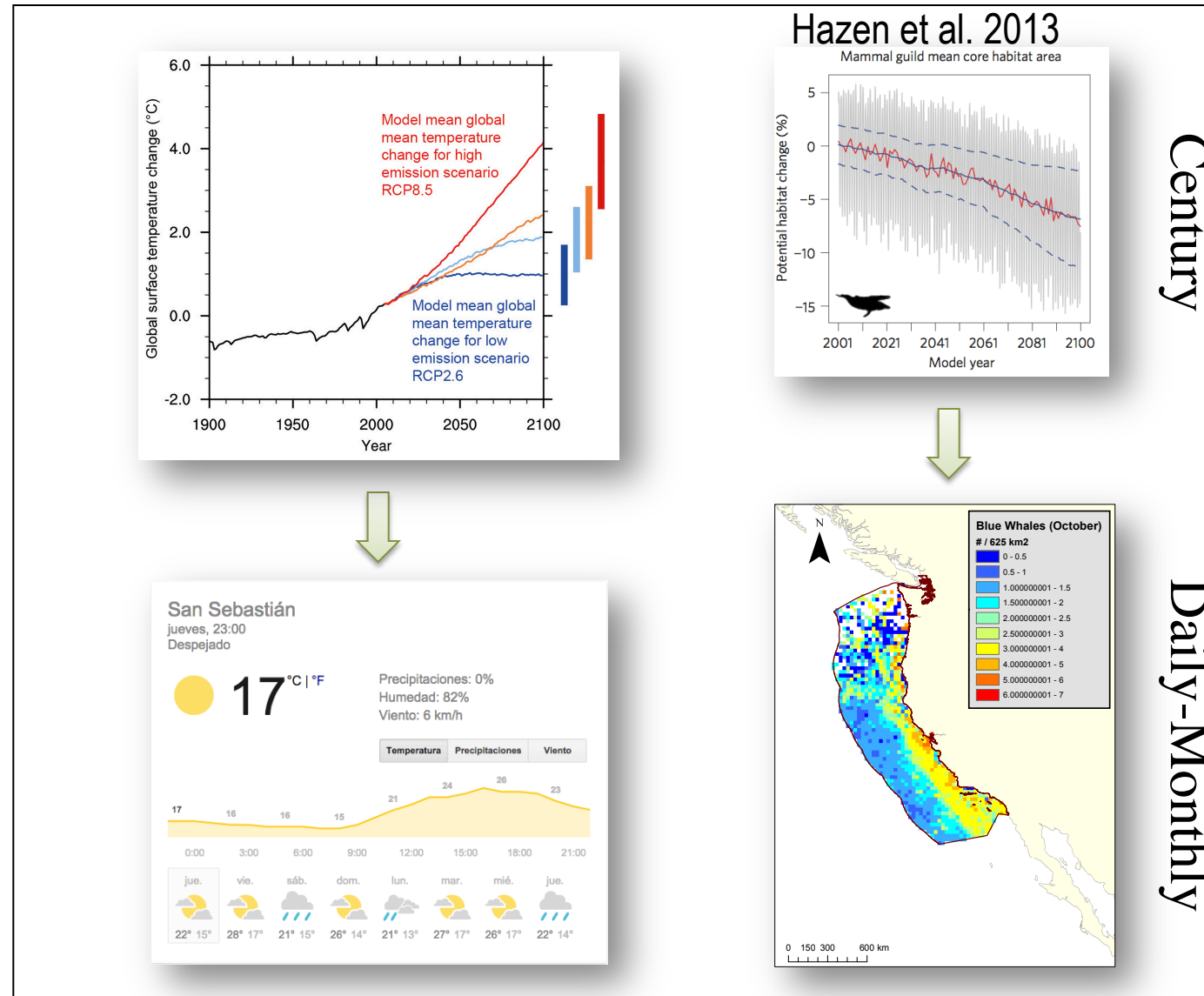
# EcoCast: Dynamic Ocean Management



# EcoCast: Dynamic Ocean Management



# From Prediction to Forecast



Hazen et al. in review

# Dynamic Ocean Management

- List item 1
  - List item 2

